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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/038,800	12/31/2001	Ching-Tien Ma	67,200-549	2943

7590 06/18/2003

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EXAMINER
BARRECA, NICOLE M

ART UNIT	PAPER NUMBER
1756	

DATE MAILED: 06/18/2003

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Please find below and/or attached an Office communication concerning this application or proceeding.

MN

Office Action Summary	Application No.	Applicant(s)	
	10/038,800	MA ET AL.	
	Examiner	Art Unit	
	Nicole M. Barreca	1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____ .

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-15 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-15 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

1. Claims 1-15 are pending in this application.

Claim Objections

2. Claim 12 is objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claim 9, on which claim 12 depends, already claimed a step of depositing the insulating material layer.

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 1-6, 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shields (US 2001/0045646) in view of Suzuki (US 5,783,459).

Shields discloses the use of a SiON ARC/hard mask for interconnection metal patterning that will not interact with conventional deep UV resist processing at about 100-300 nm [0014]. Figure 3 illustrates dielectric layer 30 (substrate) and conductive layer 32. A SiON ARC/hard mask 34 (etch stop) is deposited on the conductive layer followed by a thin oxide layer 36 and photoresist pattern mask 38. The photoresist mask comprises a DUV photoresist material (cl.8 on p.3). Etching is conducted to pattern the conductive layer. The oxide and silicon oxynitride layers are removed after

etching (cl.4 on p.3). The SiON is formed at a thickness of about 300-700 angstroms, the oxide layer at a thickness of about 20-300 angstroms, while the photoresist is formed at a thickness of about 7000-9000 angstroms. The conductive layer comprises a barrier metal at a thickness of about 250-750 angstroms and a metal layer at a thickness of about 400-8000 angstroms [0024]-[0025]. The total height of the stack (using the median thickness for all layers) is about 13,360 angstroms or 1.336 microns. The method is able to produce features of about 0.15 microns [0026], giving an aspect ratio (pattern height/pattern width) of about 8.9.

Shields does not disclose curing the photoresist with UV radiation for at least one minute, for a time period between about one minute and about 10 minutes (cl.5), or for a time period between about one minute and about 10 minutes at a temperature of at least 100 °C (cl.6). Suzuki teaches a method for patterning a metal layer wherein the photoresist is cured with UV radiation in order to reduce the amount of decomposed polymer on the pattern resist (abstract). Resist layer 41 is cured by being subjected to curing UV rays radiated onto the resist pattern 41 in order to prevent decomposed polymer from being produced on the resist pattern during the metal dry etching step carried out with reactive gas including chlorine. The curing UV rays are radiated onto the resist pattern at a temperature of 100-170 °C for approximately 90 seconds. The curing UV rays are from 180 nm to 330 nm. The cured resist pattern does not react the aluminum trichloride in the metal dry etching step and no polymer film is formed (col.6, 1-46). It would have been obvious to one of ordinary skill in the art to cure the photoresist in the method of Shields with UV radiation for about 1-10 minutes at a

temperature of at least 100 °C because Suzuki teaches that curing a resist using UV radiation at about 100-170 °C for approximately 90 seconds will prevent the formation of a polymerized film from being produced on the resist during the metal etching step.

5. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Shields in view of Suzuki as applied to claim 1 above, and further in view of Hsia (US 6,162,724).

Since Suzuki etches the metal layer using a reactive gas including chlorine species, the reference is concerned with preventing the production of a chlorocarbon polymer film and does disclose reducing the fluorocarbon polymer formation by performing a UV cure. Hsia teaches that in a conventional metallization process, it is known that a chemical compound film will be formed on the metal layer during the etching process as a result of a reaction between the hydrocarbon polymers of the photoresist and the chlorine or fluorine molecules contained in the reactive ion etching chemicals (col.2, 25-36). It would have been obvious to one of ordinary skill in the art that if a reactive gas including a fluorine species was used to etch the metal layer in the method of Suzuki, instead of a reactive gas including a chlorine species, that the UV cure would reduce the fluorocarbon polymer formation because Hsia teaches that it is known that both the chlorine and fluorine species used in a conventional metal etch will react with the hydrocarbon polymer of the resist and form a chemical compound film.

6. Claims 9-15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Shields (US 2001/0045646) in view of Jain (US 4,444,456).

Shields discloses the use of a SiON ARC/hard mask for interconnection metal patterning that will not interact with conventional deep UV resist processing at about

100-300 nm [0014]. Figure 3 illustrates dielectric layer 30 (substrate) and conductive layer 32. A SiON ARC/hard mask 34 (etch stop) is deposited on the conductive layer followed by a thin oxide layer 36 (insulating) and photoresist pattern mask 38. The photoresist mask comprises a DUV photoresist material (cl.8 on p.3). Etching is conducted to pattern the conductive layer. The oxide and silicon oxynitride layers are removed after etching (cl.4 on p.3). The SiON is formed at a thickness of about 300-700 angstroms, the oxide (insulating) layer at a thickness of about 20-300 angstroms, while the photoresist is formed at a thickness of about 7000-9000 angstroms. The conductive layer comprises a barrier metal at a thickness of about 250-750 angstroms and a metal layer at a thickness of about 400-8000 angstroms [0024]-[0025]. The total height of the stack (using the median of all given ranges) is about 13,360 angstroms or 1.336 microns. The method is able to produce features of about 0.15 microns [0026], giving an aspect ratio (pattern height/pattern width) of about 8.9.

Shields is silent on the exposure process of the DUV photoresist and does not disclose that the DUV photoresist is irradiated with UV radiation for at least one minute, or for a time period between about one minute and about 10 minutes (cl.14). Jain teaches that for a typical lamp in a typical DUV exposure system the exposure time for photoresists sensitive in the DUV range is usually several minutes (col.1, 24-33). It would have been obvious to one of ordinary skill in the art to irradiate the DUV photoresist in the method of Shields with radiation for at least a one minute or between 1-10 minutes because Jain teaches that in a typical DUV exposure system, photoresists sensitive in the DUV range are typically exposed for several minutes.

C nclusion

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nicole M. Barreca whose telephone number is 703-308-7968. The examiner can normally be reached on Monday-Thursday (8:00 am-6: 30 pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mark Huff can be reached on 703-308-2464. The fax phone numbers for the organization where this application or proceeding is assigned are 703-872-9310 for regular communications and 703-872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0661.

Nicole Barreca
Patent Examiner
Art Unit1756

June 6, 2003